PHYLUM PORIFERA

- Porifera are the lowest multicellular animals belonging to the kingdom Animalia.
- The word “Porifera” mainly refers to the pore bearers or pore bearing species.
- Based on the embryological studies, sponges are proved as animals and are classified into a separate Phylum in the animals
- This phylum includes about 5000 species. Poriferans are pore-bearing first multicellular animals. The pores are known as Ostia.
- The poriferans have a spongy appearance and are therefore called sponges. They are attached to the substratum and do not move.
- They have the ability to absorb and withhold fluids.
- They were initially regarded as plants due to the green colour and their symbiotic relationship with algae.
- Later, their life cycle and feeding system were discovered, and they were included in the animal kingdom.

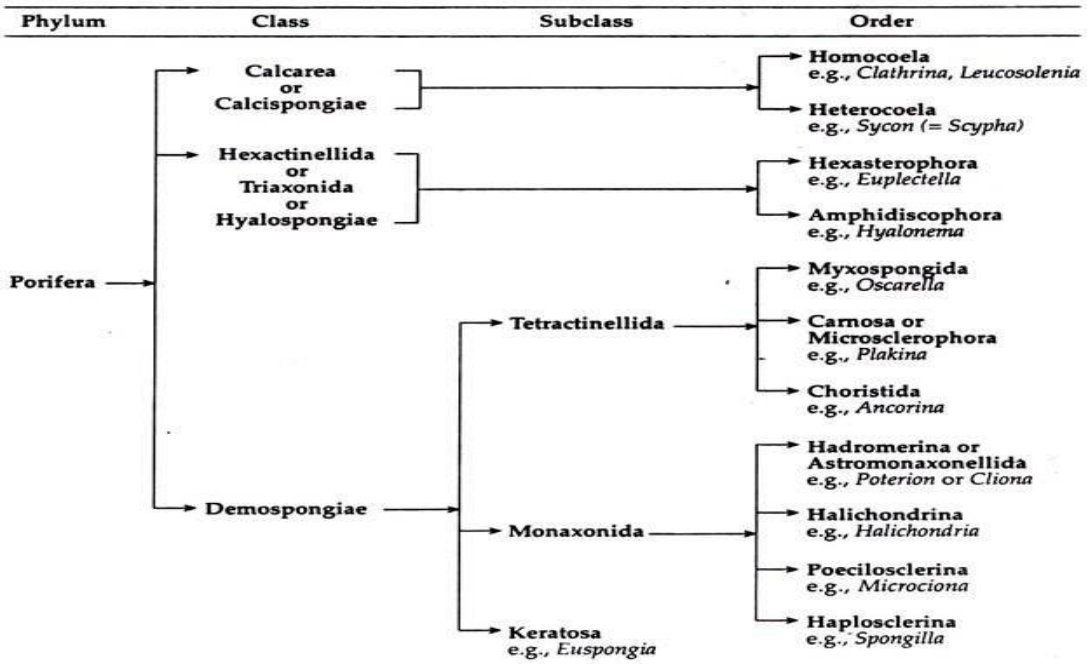
General Characteristics of Phylum Porifera

Some of the important characteristics of phylum Porifera are mentioned below.

- The cells of Poriferans are loosely organized.
- They are mostly found in marine water. Only a few are found in freshwater.
- They are either radially symmetrical or asymmetrical.
- Their body is usually cylindrical.
- The scleroblast secretes spicules while spongin fibres are secreted by spongioblasts.
- They have no organs in their body.
- They depict cellular grade of organization.
- The body comprises numerous pores known as Ostia and osculum.
- The central cavity is called spongocoel or atrium which opens to the outside through the osculum.
- They reproduce asexually by budding, and fragmentation.
- The nutrition is holozoic.

- They have neurosensory cells but are devoid of any specific nervous system.
- They have the power to regenerate the lost parts.
- The development is indirect and the cleavage is holoblastic.
- The exchange of respiratory gases and nitrogenous wastes occurs by the process of diffusion.

Classification of Phylum Porifera



Calcarea or Calcispongiae— (Calcareous Sponges):

Exclusively marine, shallow coastal water species, restricted to depth less than 100 metres and require hard substratum for attachment.

(ii) Small-sized sponges, about 10 cm in height.

(iii) Cylindrical or vase-like in shape.

(iv) Osculum narrow and placed terminally.

(v) Osculum provided with oscular fringe.

(vi) Comparatively large collared cells.

(vii) Skeleton represented by free calcareous spicules.

(viii) Spicules contain more $CaCO_3$ (87%) than $MgCO_3$ (7%) reported in Leucandra sp. and often differentiated into megascleres and microscleres. Organic matters in traces.

(ix) Megascleres are monaxon, triaxon or tetraxon.

(x) Canal system is asconoid, syconoid and leuconoid type. Asconoid type of canal system is found only in the class Calcarea.

The class Calcarea contains two orders.

Order 1. **Homocoela:**
(i) Asconoid sponges with small bodies.
(ii) Thin body wall and usually not folded internally.
(iii) Spongocoel is lined with choanocytes.
Examples :C lathrina, Leucosolenia, Ascute, Ascyssa and Dendya.

Order 2. **Heterocoela**

i. Syconoid and leuconoid sponges, comparatively with large bodies.
ii. Thick body wall and folded internally.
iii. Only the radial canals are lined by choanocytes.

Examples are Sycon (= Scypha), Grantia, Leucandra.

Class 2. Hexactinellida or Triaxonida or Hyalospongiae—(Glass sponge):

Hexactinellida, Gk. Hex = six, Gk. aktis = ray, L. ell – suffix added to form diminutives; Triaxonida, Gk. Treis = three, Gk. axon = an axle; Hyalospongiae, Gk. Hyaleos = glassy

(i)Large sized sponge and on average 10 to 30 cm in height, live mainly in the deep waters of sea and can grow in firm and soft sediments. The deep sea forms live at the depths between 200 m and 1000 m.

(ii) Usually cup, vase or urn (vase with foot)-like shape.

(iii) Skeleton of six-rayed (triaxon) siliceous spicules (SiO_2) or their modifications present either as separate entity or as networks.

(iv) Chemical analysis in Monoraphis reveals that the spicule contains SiO_2 86%, water 9%, inorganic elements 3% and spiculin (a protein) 2%.

(v) Megascleres (skeletal spicules) and microscleres (flesh spicules) always distinguished.

(vi) Choanocytes restricted to finger-like simple or folded chambers.

(vii) Wall encloses a spongocoel (- atrium) which opens by a wide osculum.

(viii) Canal system may be either syconoid or leuconoid type.

(ix) There is no cellular dermal epithelium.

(x) Commonly called “glass sponge”.

It includes two orders:

Order 1. Hexasterophora

(i) The spicules are hexasters and never amphidiscs.

(ii) Radial canals or flagellated chambers are simple and lie radially in the sponge wall.

Example is Euplectella (Venus's flower basket)

Order 2. Amphidiscophora

(i) The hexaster spicules are absent and the spicules are amphidiscs.

Examples are Hyalonema (Glass rope sponge), Pheronema (Bowl sponge).

SCYPHA - Type study

Scypha (Gr., skyphos = cup) was formerly called Sycon.

According to de Laubenfels (1936) the name Sycon must be replaced by Scypha. Scypha is somewhat more complex type in comparison to Leucosolenia because Leucosolenia is primitive asconoid type without any folding in its body wall;

The body wall of Scypha is somewhat folded and, therefore, its spongocoel is comparatively reduced.

SCYPHA (=SYCON)
SYSTEMATIC POSITION

Phylum	....	**Porifera**
Class	....	**Calcarea**
Order	....	**Heterocoela**
Genus	...	*Scypha (Sycon)*

Habit, Habitat and Distribution of Scypha:

Scypha, also known as crown sponge, is a small, marine sponge found attached by a sticky secretion to some submerged solid object like rocks, shells of molluscs and corals.

It is found in shallow water up to a depth of 50 fathoms (1 fathom = 6 feet) where waves provide the animal with plenty of food and well oxygenated water.

It is a branching colonial sponge, though solitary individuals are also found.

Scypha is widely distributed and found in abundance near North Atlantic shores.

The different species of Scypha are S. ciliatum, S. elegans, S. coronata, S. lingua, S. gelatinosum and S. raphanus.

External Features of Scypha:

Scypha is vase-shaped and is 2.5 to 7.5 cm in length.

It has several cylinders, all the cylinders are connected at the base by which it is attached by a sticky secretion to some submerged solid object in the sea.

It is grey or light brown in colour.

The distal or free end of each cylinder has a single large opening, the osculum or exhalent or ex-current pore.

The osculum is encircled by an upstanding collar of long monaxon spicules termed the oscular fringe looking like a crown, hence, the name crown sponge is given to it.

It prevents the entry of other animals into the sponge, Below the osculum is a short, narrow collar region.

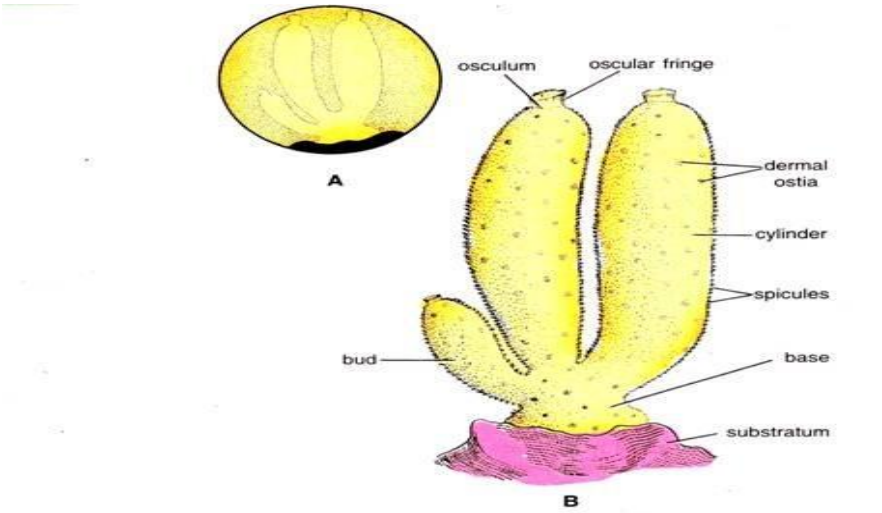


Fig. 26.1. *Scypha*. A—Colony in natural size; B—Colony magnified.

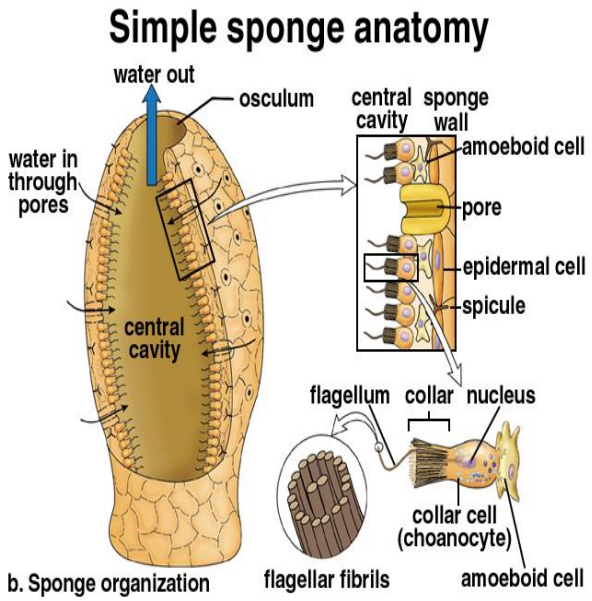
The body of the sponge is covered externally by a thin dermal epithelium or ectoderm.

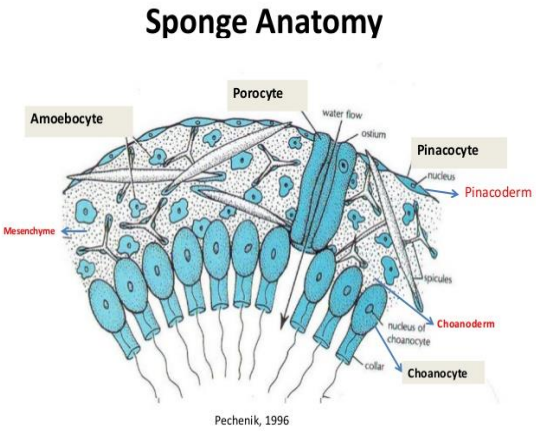
The surface of a cylinder has polygonal elevations, and between the elevations are depressed lines, in the depressions are groups of ostia which are inhalant or incurrent pores.

These are intercellular apertures and not intracellular as in Leucosolenia.

Inside each cylinder is a spongocoel (Gr., spongos = sponge; koilos = hollow) or Para gastric cavity which is not digestive cavity.

The wall of the cylinder is thick due to increase in the amount of mesogloea, the wall has folded in such a way as to form two types of canals, the incurrent canals and radial canals, they lie alternately and radially around the spongocoel,but ostia and canals are absent from the collar and basal regions





INTERNAL STRUCTURE OF SYCON

Sycon is a diploblastic animal .

The body wall is made by two layers

A) Dermal layer and B) Gastral layer.

In between them mesenchyme is present.

A) Dermal layer: This layer contains pinacocytes and porocytes.

Pinacocytes : These are simple flat, polygonal cells.

These are highly contractile.

They cover the entire outer body surface of the sponge. Pinacocytes covering the outer body surf fromthe dermalepithelium and which cover paragastric cavity and form the gastral epithelium.

Potocytes :These are tubular cells distributed among the pinacocytes.

They form the openings on the dermal layer

B) Gastral layer :

It shows choanocytes and epithelial cells.

Choanocytes : These are round cells.

They show big nucleus

A long flagellum s rises from each cell.

At base of the flagellum a protoplasmic collar is present.

The action of flagellum brings in water.

This cell is useful in digestion, respiration and other functions.

Choanoderm:

- It is an inner layer of body wall
- A single layer of flagellated collar cells of choanoderm, are called choanocytes
- A choanocyte is an ovoid cell with its free end bearing a transparent contractile collar which surrounds a single long flagellum and a nucleus at the base or apex of its cell.
- Choanocytes are used in feeding. Collar of choanocyte traps plankton (food particles) that are suspended in the water.
- Choanocytes are used in ensuring the flow of water within the animal's body by beating their flagella.
- The water current help in gas exchange, removal of wastes, and release of the gametes

C) Mesenchyme : It is present between dermal and gastral layers.

It contains amoebocytes. They are many types.

1. Scleroblasts : The amoebocytes secrete skeleton. Scleroblasts are of three types :

i) Calcoblasts: Scleroblasts that secrete calcareous spicules.
ii) Silicoblasts: Scleroblasts that secrete silicious spicules

iii) Spongioblasts: Scleroblasts that secrete spongin fibres.

2. Chromocytes: Amoebocytes with pigment and give colour to the body.

3. Thesocytes: These cells contain reserve food material.

4. Archeocytes: These are big in size. They give rise to sex cells.

5. Myocytes:

These are highly contractile cells.

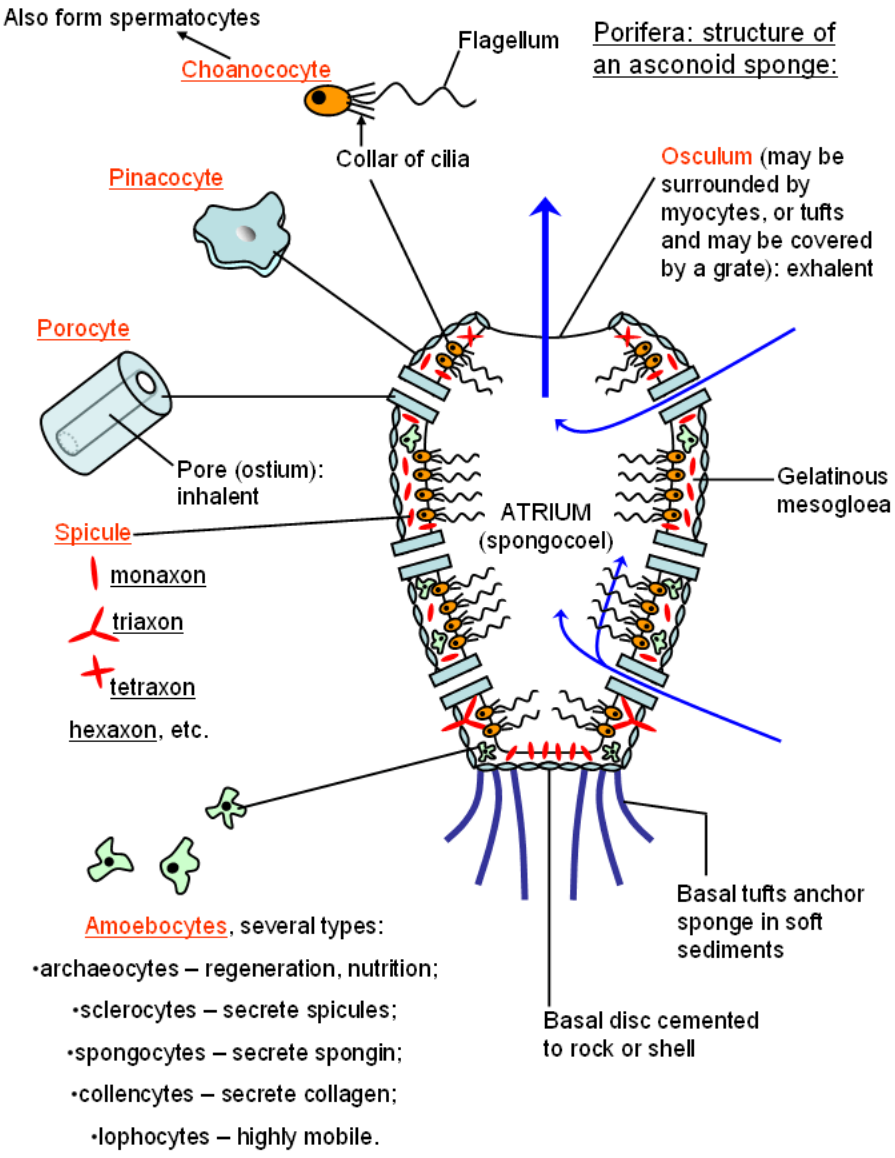
They are arranged circularly around the osculum arid other openings.

They guard and regulate the apertures.

6. Gland cells:

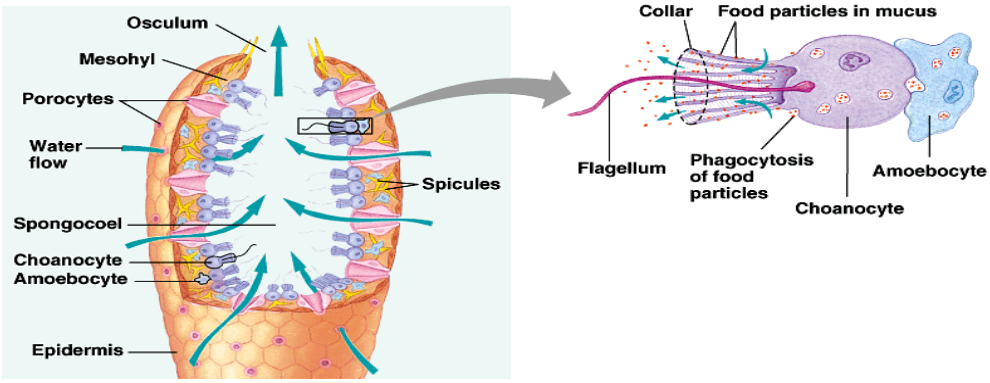
They are attached to the surface of the sponge.

They produce slime.



Food and feeding

- Is a filter feeder
- Food consists of planktons (microscopic animals and plants) and organic particles.
- They get food by circulation of water which enters through the ostia to the spongocoel.
- Openings are connected by a series of canals, which are lined by choanocytes (the flagellated collar cells) that maintain the current and filter out food particles.
- The choanocyte's collar consists of microvilli joined together by delicate microfibrils,which filter out tiny food particles.
- The beating of the flagellum draws water through the collar and out the top.
- Particles too big to pass through the collar get trapped in mucus and slide down the collar to the base where they are phagocytized.
- Some sponges also supplement their filter feeding by hosting symbionts such as green algae, dinoflagellates or cyanobacteria that provide nutrients to the sponge.



Reproduction in Sponges

Sponges reproduce both sexually and asexually.

Most sponges are monoecious. Meaning a single sponge can have both male and female sex cells.

Sperm cells develop from choanocytes. Egg cells can develop from choanocytes in some species and from archaeocytes in others.

After fertilization, the zygotes develop into a free-swimming flagellated larva called a **parenchymula**.

Paranchymula break off from the adult sponge and are carried away by ocean currents.

Sponges can reproduce asexually by **fragmentation** (this occurs when a fragment is broken off from the main body of the sponge) and by **external budding**.

Budding occurs when a small sponge grows off of the adult sponge. Eventually these can break off and regenerate.

Asexual reproduction can also occur by the formation of internal buds called **gemmules**.

Gemmules are internal buds that are usually dormant and contain archaeocytes.

Gemmules are formed during unfavorable conditions like drought, freezing temperatures, and anoxia for long periods of time.

After the unfavorable conditions pass, the archaeocytes can then be released from the gemmules to regenerate into a new sponge.

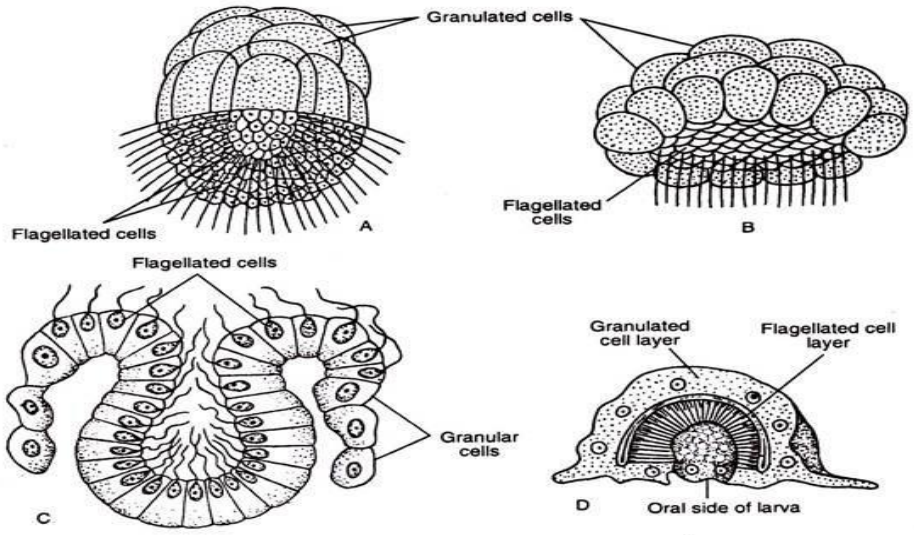


Fig. 11.8: Stages of development in *Sycon* (after Parker & Haswell). A. Amphiblastula stage. B. Invaginating amphiblastula stage. Note that the flagellated cells are going to be tucked in. C. Sectional view of late amphiblastula showing the invagination of flagellated cells. D. Fixed stage of larva (sectioned to show internal disposition).

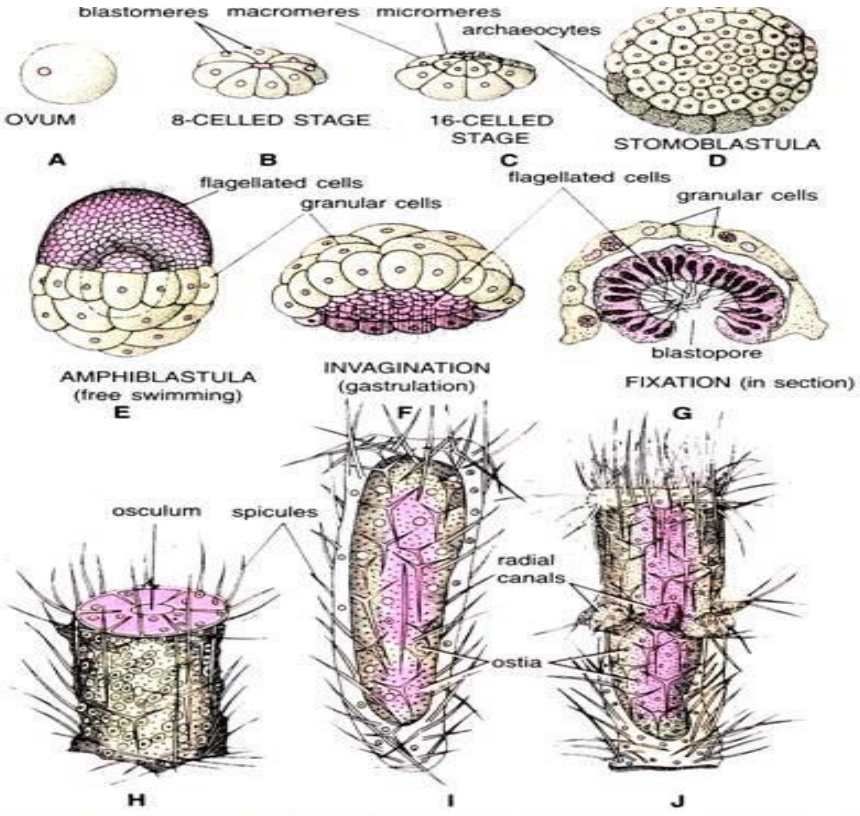
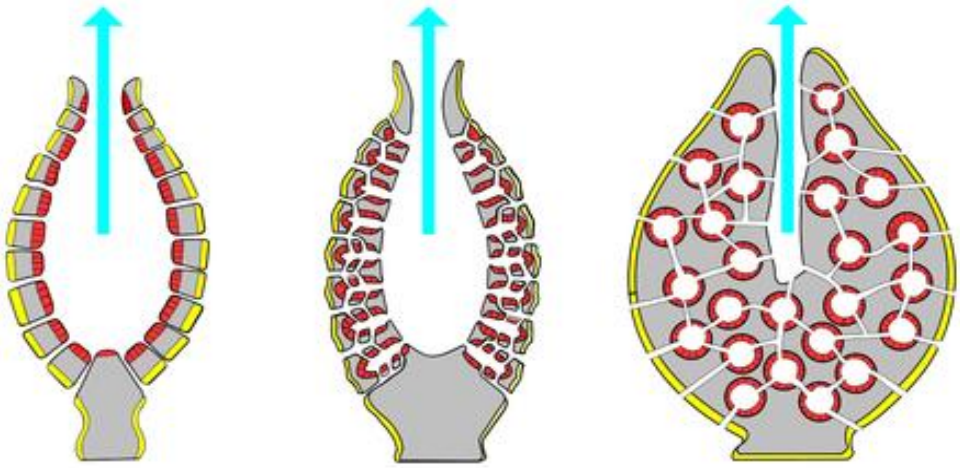
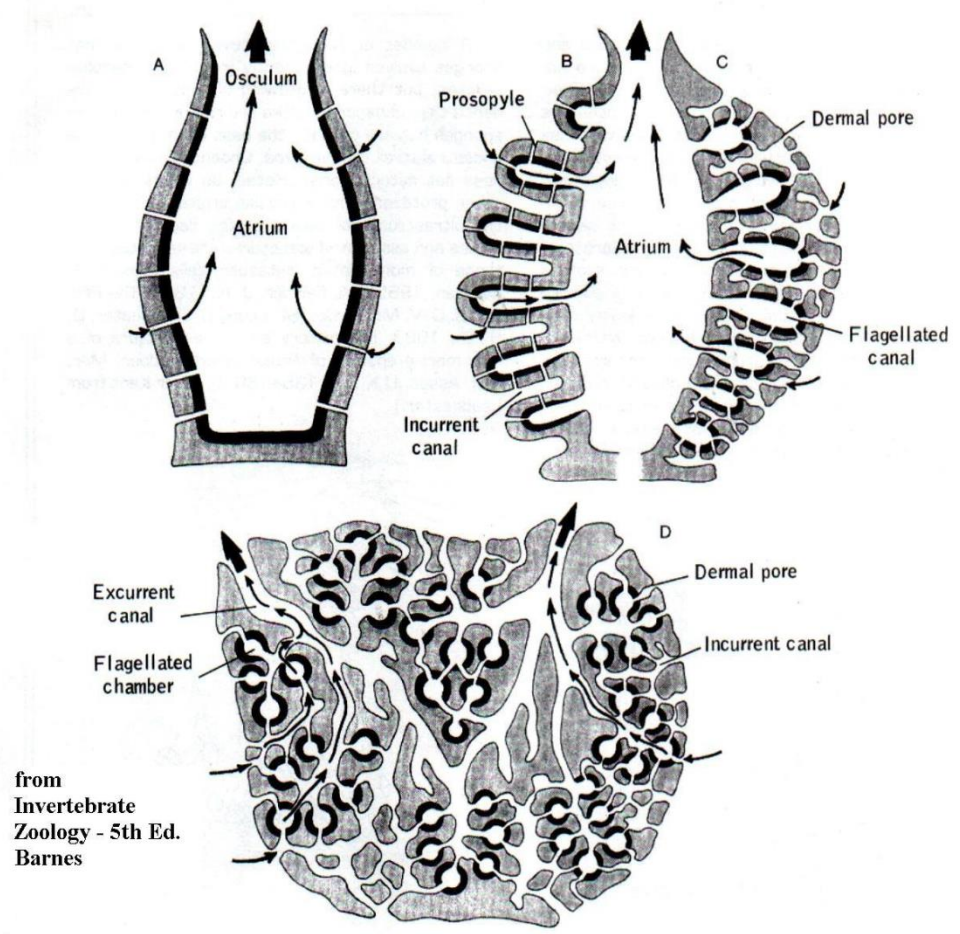


Fig. 26.12. *Scypha.* Development. A—Ovum; B—8-celled stage; C—16-celled stage; D—Blastula; E—Amphiblastula; F—Beginning of invagination; G—Gastrula showing fixation (in section); H—Young sponge; I—Asconoid (olynthus) stage; J—Syconoid stage.

CANAL SYSTEM IN SPONGES

Sponges have three types of canal systems; **Asconoid, Syconoid, and Leuconoid.**





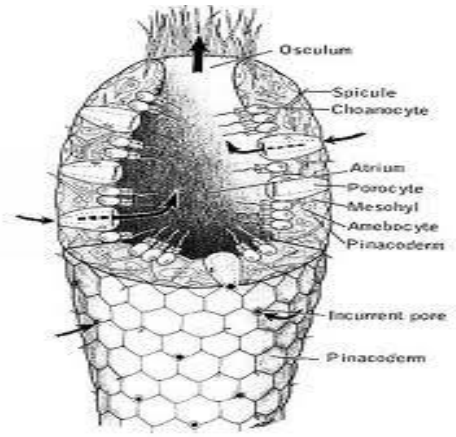
from Invertebrate Zoology - 5th Ed. Barnes

Asconoids have the simplest body plan of the sponges. They are small and tube shaped.

Water enters the ostia into a large cavity called the Spongocoel.

The choanocytes then expel the water out the osculum.

Asconoids are found only in the class Calcarea.



Syconoids

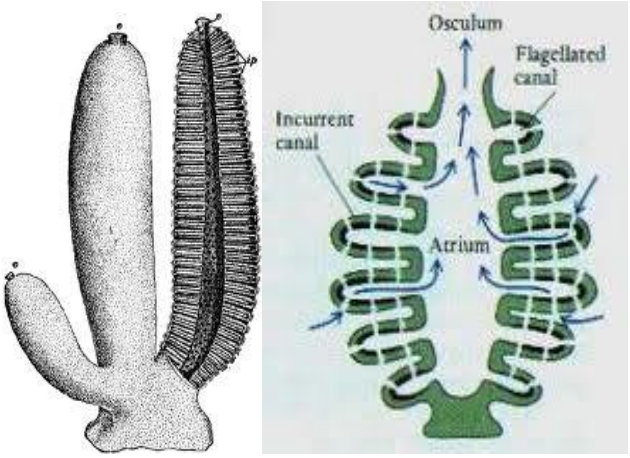
Similar to Asconoids. Water is expelled through one large osculum like in the asconoids.

Choanocytes do not line the spongocoel.

The choanocytes line individual canals along the sides of the body tube called radial canals.

Syconoids are mostly found in class Calcarea.

Some are also found in class Hexactinellida



Leuconoid

The Leuconoid body plan is the most complex.

Their unique body design allows for a much greater body size. The increased body size increases the amount of flagellated choanocytes, therefore increasing the amount of food that can be consumed.

Most leuconoids are large masses rather than simple tubes, with numerous oscula.

There is no spongocoel in leuconoids.

They are found in **all three classes** of sponge.

SPICULES IN SPONGES

Skeleton in sponges

An important structural protein in the animal kingdom and in sponges is called **collagen**.

Thin strands of collagen are found throughout the bodies of sponges.

The class of Demospongiae produces a form of collagen known as **spongin**.

Various forms of **spicules** are found throughout the different classes of sponges. They are made up of **Silica** or **Calcium Carbonate**.

- All the sponges have a skeleton embedded in the mesenchyme. Skeleton consists of separate spicules or interlacing sponging fibers or both.
- Skeleton supports and protects the soft body parts of the sponges.

Spicules - structure and types

- Spicules are microscopic crystalline structures which gives the sponges their rigidity and form.
- Spicule consists of spines or rays that radiate from a point.
- These are secreted by special mesenchymal amoebocytes called scleroblast cells.

On basis of type of deposit on core organic matter spicules are classified into two types

- **Calcareous spicules:** The organic material in this type of spicules is calcium carbonate or calcite. This is the characteristic of the sponges of class Calcarea.
- **Siliceous spicules:** The organics material in this type of spicules is Colloidal silica or Silicon. These types of spicules are the characteristic of the sponges of class Hexactanellida.

On the basis of size and function: Spicules can be of large size or small size. Accordingly spicules can be of two types:

- **Megascleres:** These are larger spicules constituting main skeleton of sponge body.
- **Microscleres:** These are the small spicules occurring interstitially.

On the basis of number of axes and rays:

Spicules may occur in several forms like the simple rod form or in the form of forks, anchors, shovels, stars, plumes etc.

The spicule forms depend on the presence of number of axes and rays.

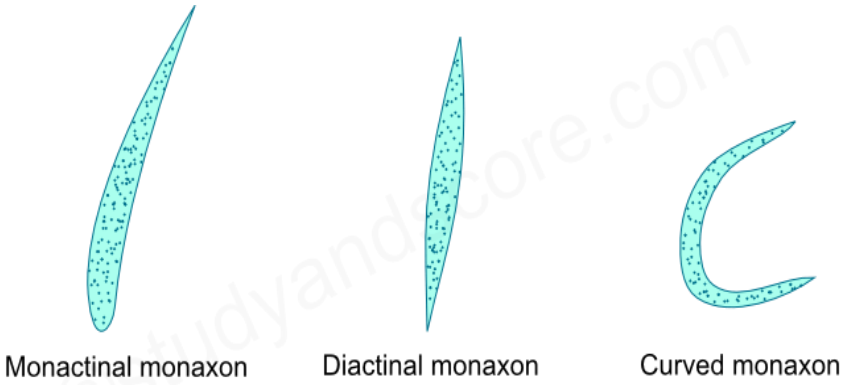
1. Monaxon
2. Triaxon
3. Tetraxon
4. Polyaxon

Monaxon:

- These kinds of spicules are formed by the growth along one axis.
- They may be straight needle-like or rod like or may be curved. Their ends may be pointed or hooked or knobbed.
- Monaxons can be both calcareous and siliceous types.

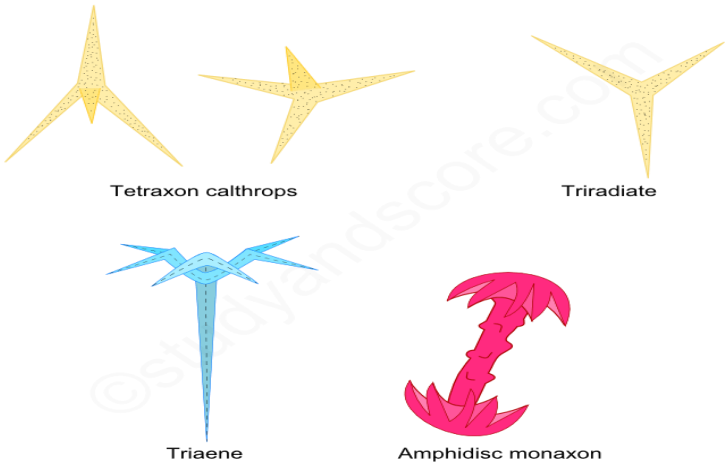
These monaxon spicules are further divided into two kinds,

- **Monactinal-** the growth of the spicule takes place only in one direction
- **Diactinal-** The growth of the spicule takes place in both the directions.



Tetraxon:

- These spicules have four rays each pointing in different direction.
- Usually one of the four rays is elongated giving the appearance of a crown of 3 rays. Such spicules are called as triaenes.
- Sometimes all the rays are equal, when all the rays are equal it is termed as calthrops.
- When all the four rays persist it is called as tetraradiate or quadriradiate.
- Sometimes one of the rays is lost and then it is known as triradiate. These triradiate rays are characteristic of calcareous sponges.
- If the elongated ray bears a disc at both ends, it is called as amphidisc.



Triaxon:

- These spicules have three axes that cross one another at right angles to produce six rays. Thus it is also called hexactinal spicule.

These triaxon spicules are characteristic of glass sponges of the class Hexactanellida.

Heactinal triaxon

Polyaxon:

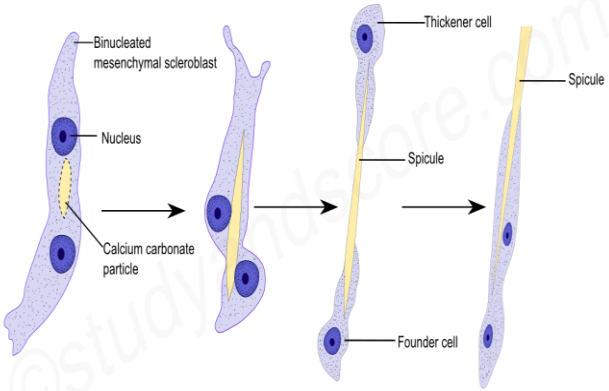
- These are the spicules with several equal rays radiating from a central point.
- They may be grouped to give star-like appearance.
- Polyaxon spicules are found along with microscleres.

Polyaxons

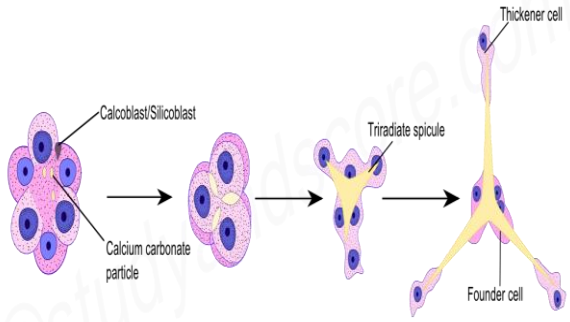
Development of spicules

- The calcareous spicules are secreted by special type of cells called as sclerocytes.
- These sclerocytes are derived from binucleated mesenchymal scleroblasts.
- A monaxon spicule or each ray of the triradiate spicule is secreted by a group of two sclerocytes.
- Among these two sclerocytes one acts as thickener cell and the other acts as the founder cell.

- The initiation of the formation of the spicule starts with the deposition of a particle of calcium carbonate between the two nuclei of the binucleated mesenchymal cells.
- This particle grows drawing apart the two nuclei and then two sclerocytes are formed.
- Now the thickener cell lays down additional layer of calcium carbonate adding to the thickness of the spicule.
- When the spicule is fully formed, both the cells i.e. thickener cell and the founder cell wander into the mesenchyme.
- The scleroblast secreting a calcareous spicule is called as calcoblast, while the scleroblast secreting a siliceous spicule is called silicoblast.



SECRETION OF MONAXON SPICULE



SECRETION OF TRIRADIATE SPICULE

Phylum Coelenterata (Cnidaria)

- Phylum Cnidaria or coelenterate includes diverse animals like jelly fish, sea anemones, corals and the more familiar Hydra.
- They are diploblastic eumetazoans with tissue grade of organization.
- The cnidarians are characterized by the presence of Cnidocytes, polyp and medusa forms.

General Characters of Phylum Cnidaria

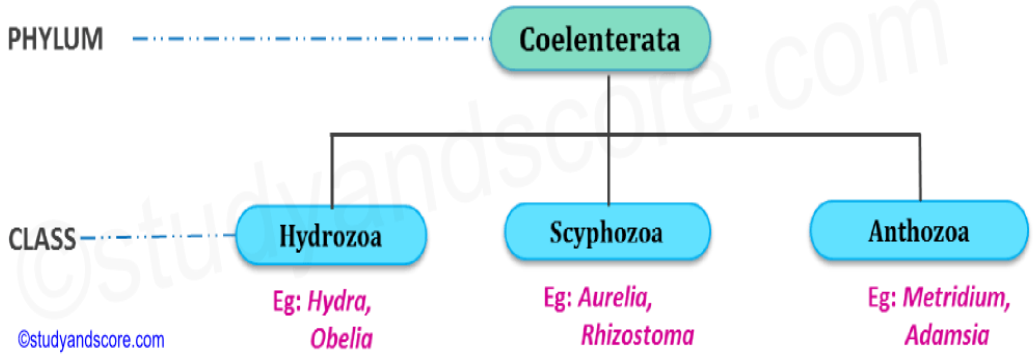
- These are mostly marine and a few like hydra live in fresh water
- Many are colonial (Eg: Corals). Some are solitary (Eg: sea anemone)
- They are diploblastic and show tissue grade of organization
- The body is radially symmetric but sea anemones show biradial symmetry
- Polyp and medusa re the two different forms of cnidarians. Polyp is hydroid form which is sessile with mouth-up orientation. Medusa is umbrella or bell shaped with mouth down orientation. It swims by constricting the bell.
- The body wall is composed of an outer epithelium called as epidermis, an inner epithelium called gastrodermis, a gelatinous mesoglea between the outer and inner epidermis. Mesoglea consists of amoeboid cells derived from ectoderm. Mesoglea is thin in polyps. It is thick in medusa, in which it is important in buoyancy.
- The body wall contains stinging cells called as cnidocytes. Hence the name cnidaria. Each cnidocyte cell contains a fluid filled membranous capsule called cnida. Cnidocytes help in defence and capture of prey.
- The blind sac-like central cavity is called coelenterons or gastro vascular cavity. Hence the name Coelenterata. It opens out by mouth surrounded by tentacles. Mouth serves for ingestion as well as for egestion.
- In medusa form the coelenterons is specialized into stomach, radial canals and ring canal. Coelenterons helps in digestion and circulation.
- Digestion is first extracellular in the coelenterons and then intracellular in the nutritive muscular cells of gastrodermis.
- Exchange of respiratory gases and elimination f the excretory wates occurs by diffusion through the body wall.
- Neurons are interconnected to form a pair of nerve nets, one in epidermis and the other in the gastrodermis. The two nerve nets are joined by neurons that

cross the mesoglea. Nerve impulse conduction is diffuse conduction. Nerve impulse can travel in any direction. Besides nerve nets, medusae have nerve rings and ganglia around the margin of the bell.

- Sensory structures like statocysts occur in the medusoid form
- Asexual reproduction takes place by budding, fission and fragmentation.
- Cnidarians are generally unisexual but some are bisexual. Fertilization is external. Cleavage is holoblastic. Development is indirect and includes a free swimming ciliated larval stage called planula.
- In species having polyp and medusa phases, the alternation of asexually reproducing polyp form and sexually reproducing medusa form is called as metagenesis.
- Cnidarians have remarkable power of regeneration.

Classification of Phylum Cnidaria

- Phylum Coelenterata/Cnidaria includes about 10,000 known species. It is classified into three classes namely Hydrozoa, Scyphozoa and Anthozoa.



Class I: Hydrozoa (Gr. Hydros=water, zoon=animal)

- These are mostly marine animals but some may also live in fresh water.
- They are chiefly colonial. Some forms may also appear solitary.
- Medusa stage is absent in few animals. Sometimes both polyp and medusa stages are present in few animals of this class. Medusa is craspedote (presence of velum)
- Coelenteron of the polyps of this class is undivided
- Mesoglea is acellular
- Cnidocytes are restricted to the epidermis
- Gonads also occur in the epidermal region

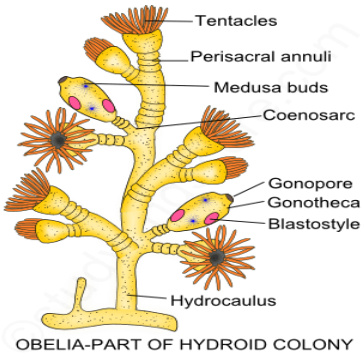
- Their colonies are polymorphic with different types of zooids like gastrozooids (feeding type), dactylozooids (defensive type) and gonozooids (reproductive type)

Class II: Scyphozoa (Gr. skyphos=cup, zoon=animal)

- All the animals belonging to this class are marine in nature
- Medusa stage is predominant in this class. Medusa is acraspedote (No velum)
- Mouth is surrounded by four oral arms.
- Mesoglea is cellular and contains amoebocytes
- Cnidocytes occur in the epidermis and also in the gastrodermis region
- Gonads occur in the gastrodermal region.
- Polyps are solitary or may also exist in colonies. Polyp stage is syphistoma (body is divided by septa). This syphistoma produces juvenile medusa called as ephyrae by the process of strobilation. Finally this ephyra grows into the sexual adult medusa.
- This class includes Jelly fish

Class III: Anthozoa (Gr. anthos=flower, zoon=animal)

- All the animals of this class are marine
- They may be solitary or colonial
- All are sedentary polyploid forms. The medusa stage is absent
- Mouth is oval and is surrounded by a whorl of tentacles resembling a flower like structure. Hence the name of the class.
- The mouth leads into tubular pharynx called stomodaeum that in turn opens into coelenteron. Coelenteron is divided into radial compartments by vertical septa called as mesenteries.
- Cnidocytes occur in epidermal as well as gastrodermal region
- Gonads occur in the gastrodermis.



OBELIA-PART OF HYDROID COLONY

Obelia Type study

தொகுதி	: குழியுடலிகள்
வகுப்பு	: ஹைட்ரோசோவா
வரிசை	: ஹைட்ராய்டியா
துணை வரிசை	: லெப்டோமெடுசா
பேரினம்	: ஒபிலியா
சிறப்பினம்	: ஜெனிகுலேட்டா

OBELIA GENERAL CHARACTERS

Distribution

- It is cosmopolitan in distribution in other words, worldwide distribution except the high-arctic and Antarctic seas.
- The medusa stage of Obelia species is common in coastal and offshore plankton around the world.

Habit and Habitat

- Obelia is sedentary, marine and colonial form.
- It is found up to the depth of 80 meters.
- It occurs in both asexual and sexual forms.
- It grows in intertidal rock pools and at the extreme low water of spring tides.

External Morphology

- Obelia is also called as Sea fur.
- The hydroid colony of Obelia is delicate, semitransparent and whitish to light brown in color.
- It consists of vertical branching stems are called as hydrocauli and the root like branches are called hydrorhiza. Both are of same thickness. The growth of the colony is sympodial.
- Each of the vertical stem or hydrocauli branches in an alternate manner.

- The ultimate branch terminates in a nutritive zooid called polyp or hydranth. In the older polyps cylindrical reproductive zooids are placed which is known as blastostyle or gonangia.
- This Obelia colony is dimorphic exhibiting two types of zooids. When the blastostyles develop saucer-shaped bodies called as medusae, the dimorphic colony becomes trimorphic.

The following are the three zooids of the Obelia colony,

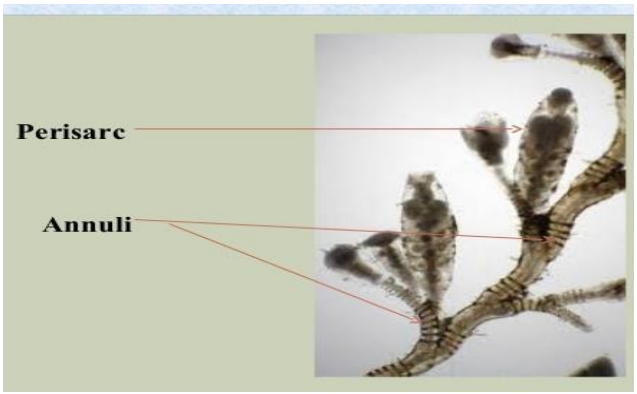
Polyp or hydranth (nutritive zooids):

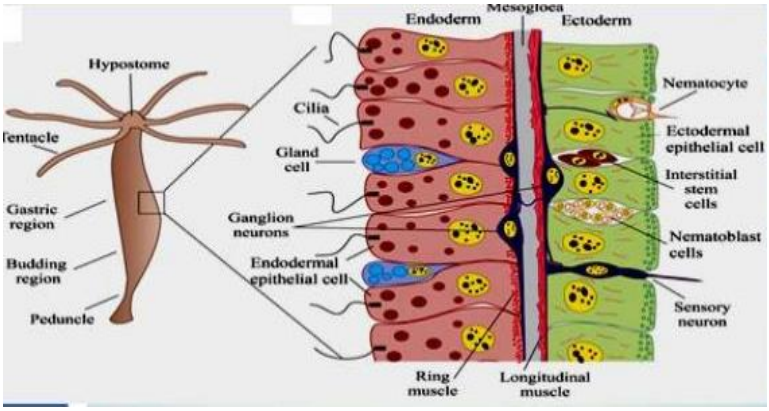
- This nutritive zooid of the colony is also known as gastrozooids or trophozooid.
- It is yellow in color, radial symmetrical and cylindrical in shape.
- They are specialized for capture, ingestion and digestion of food.
- Each hydranth is closely similar in structure to that of hydra.
- It has a sac-like body.
- The basal end is not closed but connected by a hollow stalk with the hydrocaulus.
- The body wall composed of ectoderm, mesogloea, and endoderm encloses a simple enteron that opens to outside by the mouth situated at the free end of the hydranth.
- Mouth is situated at the apex of the hypostome. The ectoderm of the hydranth is thin.
- The nematocysts are present only on the tentacles.
- The middle structure less layer, the mesogloea, has nerve net present on its both sides.
- The endoderm cells are similar to those of hydra.
- The nutritive-muscular cells possess flagella at their inner ends. The gland cells are large and with granular inclusions.
- The tubular perisarc surrounding the coenosarc extends around the hydranth to form its conical protective covering known as hydrotheca.

Blastostyle (reproductive zooids):

- After the hydrocaulus has reached its full development it gives rise to special zooids called blastostyles.
- They are fewer in number as compared to hydranths in the colony.
- The mouth and tentacles are absent in these simplified zooids.

- They cannot feed hence their enteron is reduced in size.
- The distal closed end usually forms a flattened disc.
- The perisarc extends over the blastostyle to form a cylindrical or vase-like transparent gonotheca.
- The blastostyles are the reproductive zooids as they reproduce asexually to give rise to numerous lateral buds called medusa buds or gonophores. These buds develop into third type of zooids of the colony called medusae.
- When they are fully formed they are set free and swim away from the colony by escaping through the ruptured distal end or by opening of the lid of the gonotheca.





Medusae:

- These are small, transparent, solitary, free swimming saucer-shaped or bell-shaped zooids.
- They measure about 6 mm in diameter. These are the reproductive zooids which produce the sex cells.
- The inner concave side of the body is known as sub-umbrella and outer convex as exumbrella.

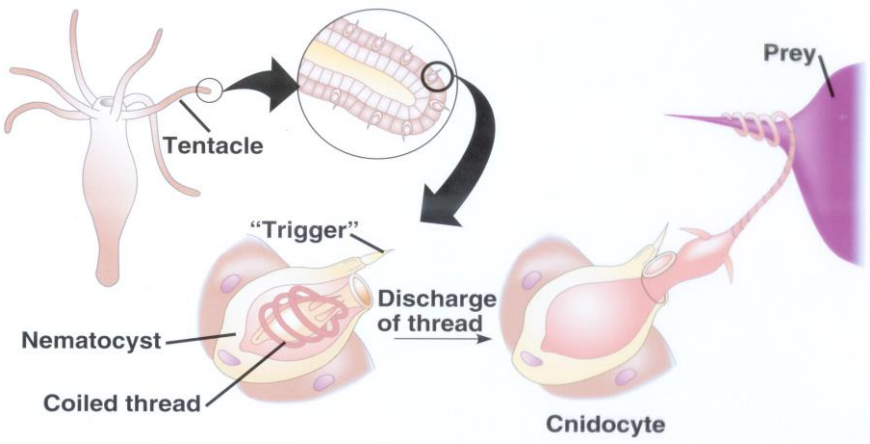
- A short, hollow, quadrangular projection, the manubrium, hangs down from the middle of the sub umbrella surface.
- This structure together with the disc or bell-shaped body of the medusa gives it an umbrella-like appearance.
- The mouth, a square or four sided opening is situated at the tip of the manubrium.
- The mouth leads through the cavity of the manubrium into a small gastral cavity or enteric cavity or stomach situated in the central part of the main body of the medusa.
- From this cavity radiate four narrow radial canals situated at equal distances from each other.
- These canals run outwards toward the edge of the umbrella and open into a circular canal running around the edge of the umbrella.
- This system of canal enables the food to be taken in at the mouth and manubrium and digested in the stomach to be distributed through them to the entire medusa.
- The edge of the medusa gives off on its inner side a very narrow, rudimentary fold or shelf called the velum.
- The margin of the umbrella gives off short tentacles which are sixteen in number in the newly born medusa but are numerous in the adult. Ectoderm covers both the surface of the umbrella and the outer surface of the manubrium.
- The endoderm lines the cavity of the manubrium, 'stomach', radial canals and circular canals which together represent the enteron. Endoderm does not extend into the velum.

Defense & Feeding Mechanism

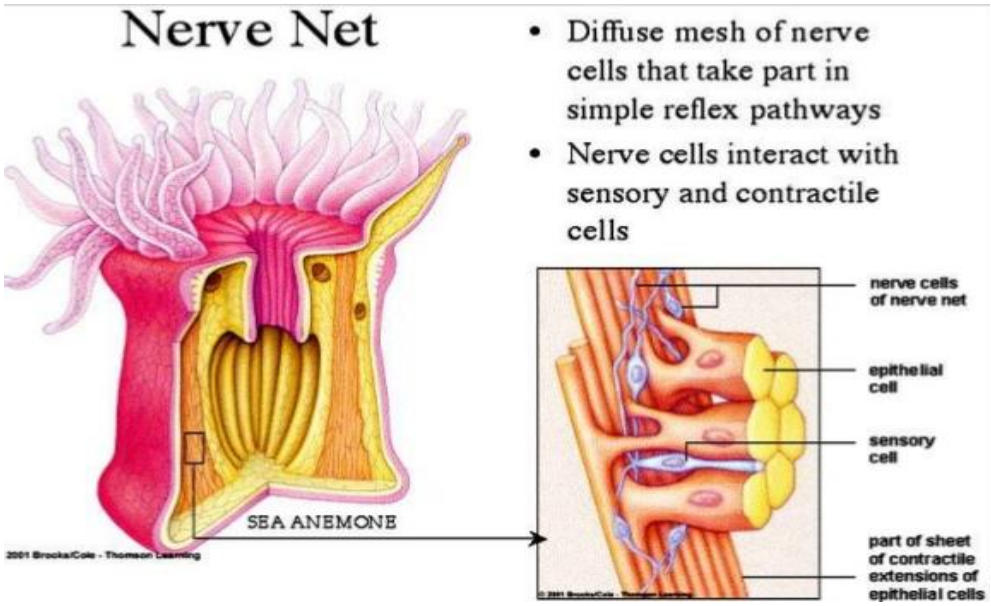
Tentacles have batteries of **Cnidocytes**

-Contain **Cnidae** – organelles that can evert

Nematocysts – stinging capsules are cnidae

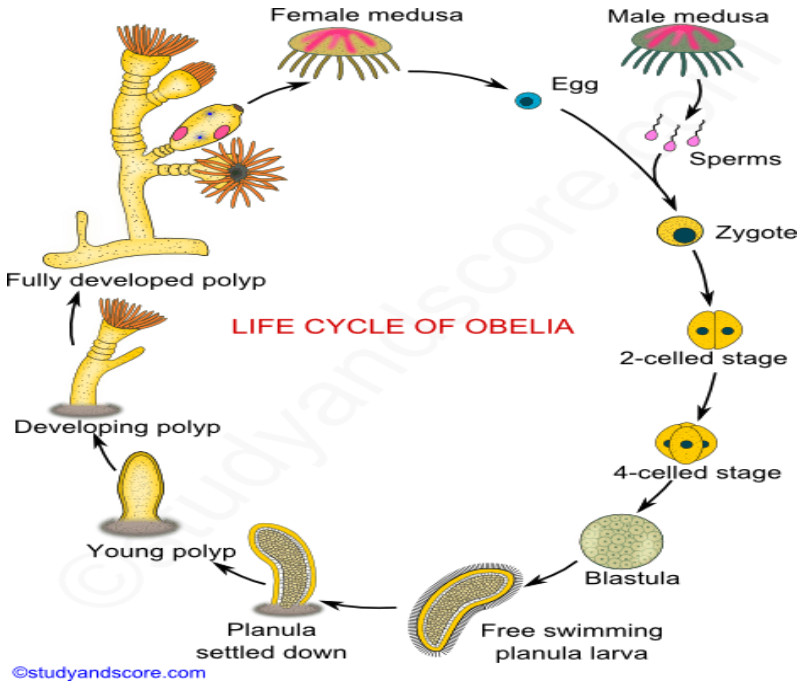


- The mouth is at the top of the body when the polyp stage takes place.
- Furthermore, this mouth is surrounded by tentacles.
- The mouth is situated at the distal end of the main body structure when the medusa stage takes place.
- Furthermore, four gonads lie in the manubrium. Also, manubrium refers to the main body structure.
  First of all, the food is enters through the mouth.
- Then it certainly makes entry to the manubrium.
- The distribution of the food takes place through a canal system.
- Moreover, this canal system consists of four radial canals and an outer ring.



OBELIA LIFE CYCLE

- The primary function of the medusa is sexual reproduction. Obelia is dioecious as each medusa has reproductive organs of only one sex.
- There is no difference between the male and female medusae.
- The gonads (testis or ovaries) are four in number and lie on the sub-umbrella, below the radial canals, in the form of knobs.
- Thus gonads are per-radial in position.
- They are situated almost at equal distances between the manubrium and the velum.
- The gonads which arise as diverticula of the radial canals have the same structure as the body wall of medusa.
- The sex cells start developing very early when the medusa is being formed.
- These cells originate in the ectoderm of the manubrium, migrate to the endoderm and finally make their way to the gonads.
- They lie between the ectoderm of the sub-umbrella and the mesogloea.


Female medusa
Male medusa
Egg
Sperms
Zygote
2-celled stage
4-celled stage
Blastula
Free swimming planula larva
Planula settled down
Young polyp
Developing polyp
Fully developed polyp
LIFE CYCLE OF OBELIA
©studyandscore.com

Fertilization:

The sperm and ova when fully formed are set free in water by rupture of the outer wall of the gonad. Sometimes the flagellated sperms swim about in water and fertilize the ova present in female medusae. The fertilization takes place in water. As medusa is the motile form, it performs two important functions for the colony namely reproduction and dispersal of the gametes.

Cleavage:

The fertilized egg undergoes cleavage which is equal and holoblastic (complete). The blastula is a hollow boll consisting of single layer of cells enclosing the blastocoel. This cavity gets completely filled up with cells budded from the wall of the blastula. The embryo is now called stereo gastrula or solid gastrula. The embryo is set free from the egg membrane as a free-swimming larva called the planula. The larva swims about for some time and brings about wide distribution of the species. A cavity soon appears in the endoderm cell mass, which becomes the enteron.

Hydrula:

After the free-swimming life the planula larva loses its cilia and settles down on the bottom of the sea, gets attached to the substratum by its broader end and undergoes metamorphosis. The attached or proximal end widens into a disc of attachment. A short distance from the free or proximal end a dilatation is formed. From this portion tentacles arise in a circle as short buds. The narrow portion beyond their origin becomes the hypostome. Soon an aperture, the mouth, is formed at the end of the hypostome. The young hydranth closely resembles a simple polyp like hydra and is called hydrula which undergoes repeated asexual budding to gives rise to complex Obelia colony.

Alternation of generation:

Alternation of generation is also known as metagenesis. It is a phenomenon whereby, in the life history of an organism, a diploid asexual phase and a haploid sexual phase regularly alternate with each other.

In Cnidaria, two types of individuals exist namely a polyp and a medusa,

Polyp:

The tube like zooid is called polyp. The polyp reproduces asexually It is sessile and attaches to a substrate at the aboral end. It has a cylindrical body called the column. Its mouth is surrounded by food-gathering tentacles.

The body structure of polyp form is simple with simple muscles and nervous system. Velum is absent. Mouth is circular without oral lobes. Also its gastro vascular cavity is simple without radial circular canals. Sensory organs are absent in this form. This form reproduces asexually by budding.

Medusa:

The umbrella like zooid is called medusa. The medusa is dioecious and free swimming. Its shape is like an inverted bowl. The tentacles hang from its margins. The mouth opening is centrally located at lower side. The medusa swims by medusa than in a polyp. It gives the medusa a jellylike appearance.

The body structure of medusa form is complicated with well-developed muscles and nervous system. Velum is present around the margins of the umbrella shaped body. Also its gastro vascular cavity is well-developed with radial and circular canals. Sensory organs called as statocysts are present on the margins of the tentacles. These forms reproduce sexually through gametes.

These two forms, polyp and medusa alternate successively where the polyp reproduce asexually to form a large number of medusa, each medusa reproduce sexually by the union of eggs and sperms to form zygote. The zygote grows into larva, which fix itself to a substrate and finally form a new polyp

POLYMORPHISM IN COELENTERATES

Coelenterate animals may show a number of zooids. They are of different forms. They take up different functions. These are called **polymorphism**. This phenomenon is called polymorphism. (Such a colony is called 'Polymorphic' colony). Polymorphism denotes division of labor among the zooids of the individual.polymorphism is one of the Coelenterate animals characteristics feature.

A polymorphic colony contains many individuals called zooids. They are mainly two types.

1. **Medusae**
2. **Polyps**.

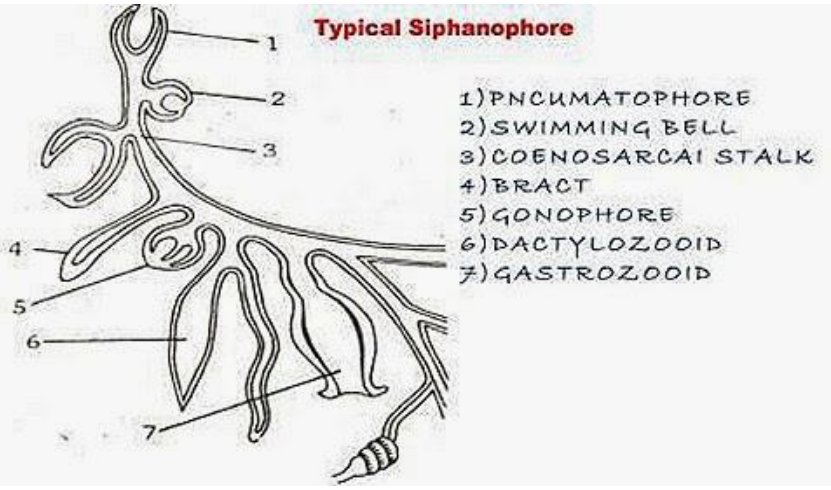
Polyp is sedentary. It shows mouth and tentacles at the free end. The medusa is free swarming. Hydra is a **Monomoiphic** form. It is represented by polyp form. It

performs all functions. Obelia like animals Show two forms, polyp nutritive zooid and medusa reproductive zooid. This is called **dimorphic organism** In a colony of obelia
1) Hydranth (a Polyp stage)
2) Blastostyle (asexually, reproducing zooid).
3) Medusae are present.

POLYMORPHIC TENDENCY IN SIPHONOPHORA ANIMALS

The polymorphic tendency reached its peak in coelenterate organisms belonging to order 'Siphanophora' of class 'Hydrozoa'. Many siphonophora organisms will show complicated structures.

Structure of a typical Siphonophora organism:



In Hydrozoan coelenterates polymorphic tendency is well developed. The order Siphonophora organisms are exhibiting this tendency to a maximum extent. In a generabsed siphonophora organism several forms are seen. These forms or zooids are developed from polyps or medusae. These individual zooids are attached to a common stalk called Coenosarc.

POLYPOID ZOOIDS ARE :

1)Gastro zooids

2) Dactylo zooids

3)Gono zooids

MEDUSOID ZOOIDS ARE:

1) Pneumatophore

2) Nectocalyces

3) Bracts

4) Gonophores

1. Gastrozooids : The nutritive polyps are called gastro zooids. They alone take up nutrition in the colony. They are tubular. A mouth is present at the tip of the hypostome. Near the base of a gastrozooid usually a single, long and contractile tentacle arises. It shows batteries of nematocysts. Lateral branches are present called

tentilla. Gastrozooids catch the prey and digest it. The digested food is thrown into the coenosarcal canal.

2. Dactylo zooids : They are called Palpons, feelers or tasters. They resemble the gastrozooids. They do not show mouth. Their basal tentacle is un branched. In Physalia, the tentacle is very long. In velella and Porpita the margin of the colony bears long and hollow tentacles. These zooids are protective in function. They bear batteries of nematocysts.

3. Gonozooids : The reproductive zooids are called gonozooids. They have no mouth. In Physalia the gonozooid shows branched stalk, bearing clusters of gonophores (gonopalpon). Gonozooids produce medusae called gonophores.

MEDUSOID FORMS :

1. Pneumatophores : It functions as a float. It is an inverted medusan bell. The walls are two layered and highly muscular. The epidermal lining becomes glandular to form a gas gland. The gas gland secretes gas into the air-sac

1)The pneumatophore is small in Halistemma.

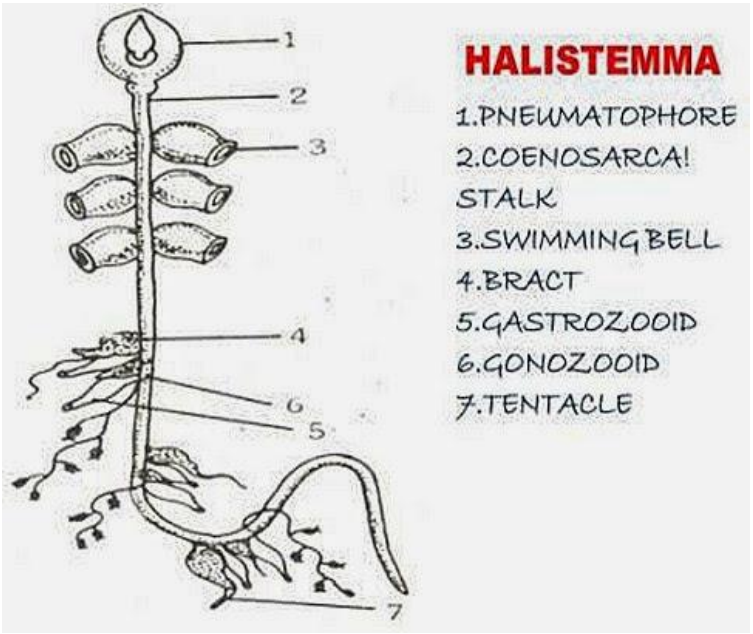
2)The pneumatophore is very large in Physalia.

3)It is disc-shaped in porpita.

2.Nectocalyces : These are swimming-bells. They are medusoid. Mouth, manubrium, tantacles and sense organs are absent. They are helpful in swimming.

3.Bracts : They are also known as hydrophyllia. They are leaf like. In Halistemma a bract covers the zooids of a cormidium.

I. Halistemma: This Siphonophora organism will show the greatestpolymorphic tendency. It is a marine organism. It spims in the sea water. It looks-like a single individual. It floats on the top of the sea water. This animal show many kinds of zooids. These are arranged in the coenosarc which is divisible into 2 parts.


1
2
3
4
6
5
7
HALISTEMMA
1.PNEUMATOPHORE
2.COENOSARCA!
STALK
3.SWIMMING BELL
4.BRACT
5.GASTROZOOID
6.GONOZOOID
7.TENTACLE

a)Nectosome

b)Siphonosome

a) **Nectosome** : It is the upper part of the coenosarc. It shows pneumatophores and swimming bells (nectocalyces).

i) Pneumatophores- On the top of the colony a float is present. It is a modified medusoid zooid. It is filled with gas. It is useful to float the cobny on the water.

ii) Swimming bells - Nectocalyces : Below the float a long stalk is present. It is called 'Coenosarcai stalk'. Just below the pneumatophores 3 to5 pairs of swimming bells are present. They are muscular. Because of them the organism swims. These bells are modified Medusae.

b) Siphonosome : The coenosaroal stalk below the swimming bells is siphanosome. On this, groups of zooids will be present called cormidia. Each cormodium includes.

1) Bract 2) Gastrozooid 3) Gonozooids 4) Dactylozooid

1.Bract : It is also called *Hydrophillum*'. It is a leaf of structure. It will cover other zooids of the cormidium.

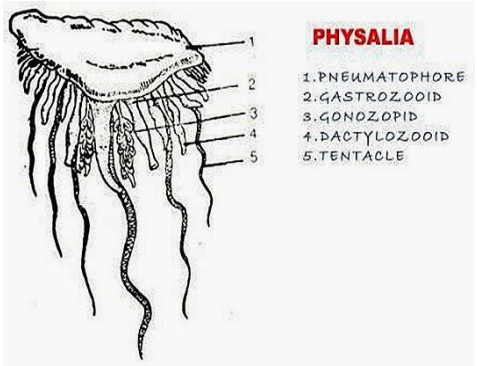
2. Gastrozooid : It is a nutritive zooid. It is a modified polyp. It has mouth at its apex. From its base along tentacle will arise. On this tentacle many nematocysts are present. They are helpful in the capturing the prey. The tentacle shows branches called Tentilla'.

3.Gonozooids : It is a reproductive zooid. It produces medusae They take up sexual reproduction.

4. Dactylozooid : It is a modified polyp. It has no mouth. It is a protective zooid. It is defensive in function. At its base a long tentacle is present.

Many such cormidia are arranged on the coenosarcal stalk. Thus Haliste-mma shows the highest degree of polymorphic tendency in Coelenterates.

II. Physalia : It is called *Portuguese-Man-of war'*. It shows a big float called pneumatophore. Below this pneumatophore stalk is absent. All the zooids are arranged below the float.



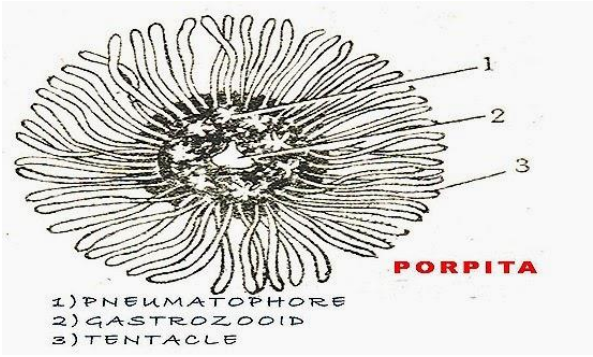
Pneumatophore : It is big and colourful. It is filled with gas. It contains gas glands. They secreate gas. With the help of the float the colony floats on the water.

Gastrozooid: It is a modified polyp. It has a mouth at its tip. It has a long tentacle at its base. The tentacle bears nematocysts. They are helpful in capturing the prey.

Dactylozooid : It is a modified polyp. It has a mouth and tentacle. It bears a number of nematocysts. Dactylozooid is defensive in function.

Gonozooid : They produce medusae which take up sexual reproduction.

III. Porpita : This siphonophore organism will show polymorphic nature. The pneumatophore is large and circular. It contains gas chambers inside.



They are separated by partitions. On lower side of the float a big gastrozooid is present. Around the gastrozooid a number of gonozooids are present Gastrozooid is a modified polyp. It has a mouth at its tip. It takes up the function of nutrition.

The gonozooids are useful for reproduction. On the rim or margin of the disc a number of tentaculozooids are present. They are called' Feelers' or Palpons. They are defensive in function. Thus porpita shows polymorphic tendency.

ORIGIN OF POLYMORPHISM:

a) Poly-organ Theory: This is proposed by 'Huxley' and others. According to them the indivldualsof the colony are the organs of a single medusoid individual i.e., mouth, tentacles, manubrium of the zooid will multiply into different types of zooids and

migrate from their original position. Thus a polymorphic individual is formed. According to this theory the polymorphic individual is a single organism.

b) Polyperson theory: Vogt and Gegenbaur proposed this theory. According to them siphonophores are polymorphic colonies of modified polyps which can produce medusae.

Hackel. Balfour agreed the colonial nature of a siphonophore but it was developed from a primitive zooid probably a medusa.

Polymorphism is associated with life history of a coelenterate animal. The asexually reproducing polyp and sexually reproducing medusa will be combined in the form of 'Cluster' and a polymorphic individual is developed.

C) **Medusome theory**: This theory was proposed by Haeckel (1888) as a compromise between the above theories. The theory says that the siphonophore larva formed from gastrula was a medusoid individual, from which zooids or persons appeared by budding from the subumbrella.